UNITED STATES TARIFF COMMISSION
WASHINGTON

INFORMATION CONCERNING

The Magnesite Industry

PRINTED FOR USE OF
COMMITTEE ON FINANCE
UNITED STATES SENATE

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OFFICE, 1322 NEW YORK AVENUE, WASHINGTON, D. C.

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LETTER OF TRANSMITTAL.

UNITED STATES TARIFF COMMISSION,
Washington, December 9, 1919.

The Committee on Finance of the United States Senate:

I have the honor to transmit herewith, in accordance with your request, information compiled by the United States Tariff Commission on magnesite, crude and calcined.

Very respectfully,

THOMAS WALKER PAGE,
Acting Chairman.

THE MAGNESITE INDUSTRY.

INTRODUCTORY STATEMENT.

Magnesite is a natural carbonate of magnesium. When pure it contains 52.4 per cent carbon dioxide (CO_2) and 47.6 per cent magnesia (magnesium oxide MgO). It is harder and heavier than limestone, which it most nearly resembles. Two markedly different natural varieties are distinguished, crystalline and massive.

The massive is a chalk-white, compact, fine-grained variety usually found in veins or masses in serpentine rocks, while the crystalline is blue, red, and gray, medium or coarse grained, and occurs only as masses in altered limestone. The only important crystalline deposits are found in Austria-Hungary (Styria), Quebec, and Washington. Massive magnesite is widely distributed.

Magnesite when calcined forms a highly refractory material which has no thoroughly satisfactory substitute in the open-hearth process for making steel. About 82 per cent of the domestic consumption is used in refractories, 15 per cent in the plastic trade, and the remainder is required in minor uses in chemical industries and medicines.

SUMMARY OF THE DOMESTIC SITUATION.

The United States is the largest consumer of magnesite in the world. Its consumption in 1913 was 50 per cent of the total output of the world. Before the war, fully 90 per cent of the domestic supply was imported. Austria-Hungary furnished the bulk of the material required by the steel industry, while Grecian deposits supplied most of the requirements for other purposes. The only domestic production was in California, where it was consumed locally.

With the outbreak of the war, supplies from Austria were at once cut off and, after 1916, those from Greece were greatly curtailed. At the same time the domestic requirements increased greatly. In 1917, the domestic consumption was over 355,000 tons, valued at more than $3,700,000. Nearly 90 per cent of the supply was of domestic origin. A great new industry was developed in Washington, while the existing industry in California was greatly expanded. Similarly fostered by the restriction of ocean shipment, a magnesite industry sprang up in Quebec which, in spite of the inferior quality of the product, was a strong competitor of the western magnesite because of the relative cheapness of the Canadian product at the eastern steel furnaces.

The chief handicap of the domestic magnesite producer is the long railroad haul from the mines to eastern markets, where it is chiefly consumed. Domestic reserves are ample, especially in Washington, where more than 7,000,000 short tons are indicated or in sight, and they have been actively exploited by two or three strong companies and several small operators.

The American magnesite is purer than the Austrian material, which, by virtue of its content of the proper amount of iron, is better suited by nature for use in the steel industry. The early difficulties encountered in the use of domestic material, however, have been satis-

factorily overcome. The lack of the desired amount of iron in Washington magnesite is made up by adding iron synthetically.

With the return of normal shipping conditions, the American magnesite industry faces the prospect of a serious relapse—almost to the pre-war level. Recently developed deposits in Venezuela may be expected to furnish some material to the eastern markets in competition with that from Greece and Canada, but Austrian magnesite will dominate the market if delivered at anything like pre-war prices, which were as low at the Atlantic seaboard, practically the point of consumption, as quotations of the domestic product on the Pacific coast. Under these conditions, the domestic output would be restricted to the markets west of the Mississippi where the consumption is comparatively small. The definitive line is dependent upon the balance of ocean freight from foreign countries and domestic rail tariffs from the Pacific coast, but the advantage lies with the foreign producer, due to the concentration of the steel industry in Pennsylvania, Illinois, and neighboring localities.

MARKET GRADES AND USES.

Magnesite is marketed either (1) crude or (2) calcined. Crude magnesite is the material as mined except that it may be sorted or undergo a simple cleaning operation to remove admixed rock waste. A very small use of the crude material is as a substitute for barite in paint manufacture. Some is made into magnesium salts; but practically all the product is calcined; yielding, according to the temperature, either caustic or dead-burned magnesia.

(*a*) Caustic magnesia (moderate temperatures) is magnesite from which most of the carbon dioxide is driven off, but from 3 to 8 per cent is intentionally left in the residue. In this form the residual magnesia reacts readily with water and carbon dioxide in the air (compare quicklime) and readily combines with various acids for the manufacture of salts. Mixed with magnesium chloride (which may be made from magnesite and muriate acid, but which is generally derived as a by-product in salt manufacture), caustic magnesia is made into Sorel ("oxychloride") cement. This mixture, generally modified by the addition of various filler materials (wood flour, cork, talc, silica, asbestos, clay, marble dust, sand, etc.), together with suitable coloring matter is sold under various trade names. It is one of the best floorings. The use of magnesite cement in floors and as stucco and wall or outside plaster is gaining importance. It sets much quicker than Portland cement and has the peculiar advantage of great resiliency. As the determining factor in ordinary floors is the deflection under load, the large deflections possible with this material permit lighter and cheaper building frame construction. Calcined magnesia is also used in making magnesium bisulphite for disintegrating wood pulp in paper making.

(*b*) Dead-burned magnesia (heated to incipient fusion) is magnesite from which the last traces of carbon dioxide have been removed. In this state, it will not slake or combine with chemicals. It is largely used for basis open-hearth steel furnaces, converters, and kilns for sulphuric acid (pyrites) burning, and in electric furnaces. Dead-burned magnesia comes in the form of brick and grains.

Carbon dioxide may be saved, but only when caustic product is to be made. The character of the calcination for the production of dead-burned magnesite is not suited to the recovery of gas.

Metallic magnesium, magnesium oxide and salts are rarely made from magnesite. In most cases a supply of by-product magnesium chloride is more cheaply available and the use of magnesite for these purposes is exceptional. Magnesia for chemical and medicinal use as well as pipe covering material, light carbonate and other products come in this class.

SUBSTITUTES.

High magnesian dolomite is a material that has proved to be a fairly satisfactory substitute for magnesite in many classes of metallurgical work. In 1913, 178,530 tons of calcined magnesite were consumed in the United States; in 1917, 177,524. For the large increase in steel made in 1917 over 1913 the difference was largely made up by use of dolomite. It is much cheaper and far more widely distributed than magnesite, but is not so refractory. Slight changes (high lime slags) in furnace processes are often necessary in using this material. Locally, serpentine rocks are possible sources of magnesium and its compounds, while magnesium salts are by-products of the common salt and potash-salt industries. Bauxite is another basic refractory material, and may take the place of magnesite in certain classes of metallurgical work. Patented products consisting of dolomite treated with furnace dust and roasted "kendymag," "syndolag," and "magnibrent" have come into more or less satisfactory use at steel plants.

TARIFF CLASSIFICATIONS.

Both caustic and dead-burned magnesite are included as "calcined" not purified, and are classed with crude magnesite under paragraph 539 on the free list (act of 1913). Magnesite brick (par. 71) differs from dead-burned magnesite only in having been molded into definite forms subsequent to calcination.

In the chemical schedule (par. 42) "Magnesia: Calcined and carbonate of, precipitated," are listed as dutiable, while conceivably these products accord closely in chemical composition with calcined and crude magnesite. The intent of the act is clear in that they are (generally purer) products produced by chemical processes from magnesium salts, especially those from Stassfurt, Germany.

DOMESTIC PRODUCTION.

The maximum domestic production of magnesite was in 1917, when the total output amounted to 316,838 short tons and was valued at $2,899,818 at the mines. The 1918 production was on a somewhat reduced scale, due to competition from Canada and a more general use of substitutes (notably, burnt dolomite in some of the eastern metallurgical plants and even in the paper trade).

The calcining capacity of the California plants is estimated at 10,000 tons per month. In Washington, considering one plant alone,

there is a calcining capacity of 10,000 tons per month, making the present available capacity of the country in excess of 20,000 tons per month, or 240,000 tons per year, which is more than ample for our present requirements.[1]

The total investment in California and Washington in the magnesite industry is estimated[1] as from $3,500,000 to $4,000,000, with the normal employment of 1,000 to 1,500 men in the producing and transporting end of the business. In tariff hearings before the Ways and Means Committee (July 16 and 17, 1919) a certain witness for the American Refractories Co. estimated that this investment has not exceeded $500,000.[2]

Magnesite has been produced in the United States since 1891. Prior to the outbreak of the European war California was the only producing State. The total output, averaging about 10,000 tons, was consumed locally, chiefly in the manufacture of paper. In 1913 and 1914 a small amount was taken by makers of stucco and Sorel cement, especially for use in the buildings of the Panama Pacific Exposition.

The first magnesite produced in the State of Washington was 715 tons mined in December, 1916. In 1917 the State yielded 105,000 tons and in 1918, 147,528 tons, an output nearly twice as large as that of California.

Production in United States.[1]

[From Mineral Resources, U. S. Geological Survey.]

Years.	Quantity (short tons).	Value.	Years.	Quantity (short tons).	Value.
1900	2,252	$19,333	1913	9,632	$77,056
1904	2,850	9,298	1914	11,293	124,223
1909	9,465	37,860	1915	30,499	274,491
1910	12,443	74,658	1916	154,974	1,393,693
1911	9,375	75,000	1917	316,838	2,899,818
1912	10,512	84,096	1918	231,605	1,812,601

[1] Prior to December, 1916, California was the only producing State.

LOCALITIES OF PRODUCTION.

Magnesite occurs in commercial quantities in California, Nevada, and Washington. Reports of workable deposits in other States have not been verified.

Domestic production of magnesite, crude, by States.

[From Mineral Resources, U. S. Geological Survey.]

States.	1916		1917		1918	
	Quantity (short tons)	Value.	Quantity (short tons)	Value.	Quantity (short tons)	Value.
California	154,259	$1,388,331	211,663	$2,116,630	84,077	$761,811
Washington	715	5,362	105,175	783,188	147,528	1,050,790
Total	154,974	1,393,693	316,838	2,899,818	231,605	1,812,601

[1] W. C. Phalen, Min. and Sci. Press, Aug. 30, 1919.
[2] Testimony of Hon. James Francis Burke, magnesite hearings, p. 193.

California.[1]—Magnesite deposits occur in numerous localities throughout the Coast Range and on the west slope of the Sierras, from Mendocino and Placer Counties on the north to Riverside County on the south. In nine counties the deposits are large, while in four counties only small deposits have been found. In 1917, 63 per cent of the crude magnesite produced in the State came from Tulare County. The rest of the production came from widely separated deposits.

With one exception (Bissell, Kern County) all the California magnesite deposits occur as irregular veins, lenses, masses, or stock work in serpentine rock. In a few places the veins or masses are 20 feet or more in width, but more generally the veins are narrow and separate lenses are irregularly disposed.

Washington.[2]—Deposits of crystalline magnesite have been found in several sections in the northeastern part of Washington (Stevens County) about 60 miles north of Spokane. The Washington magnesite differs markedly in character from the California material and is found in large masses. The larger deposits are 200 or more feet thick and 1,000 or more feet long. Estimates of 1,000,000 tons, each within 100 feet of the surface, are reasonable for at least three of the deposits.

Most of the Washington magnesite is colored, generally rather dark, and its grade must be determined by chemical analysis, as it can not be judged by its appearance.[3] It is considered better for refractory purposes than the California grade, but the latter is preferred for building purposes.

MINING METHODS.[4]

In California, the greater part of the magnesite occurs in the form of veins or lenses of variable length and thickness in massive serpentine. Some of the magnesite masses are as much as 30 feet in thickness and from this thickness they range to mere stringers and gash veins too thin to work. The magnesite is of the amorphous type.

Where the veins are thick and steeply dipping, various mining methods are employed, depending on the thickness and dip of the veins. Glory holes are dug where the masses are very thick, but overhand stopping with black filling, is the usual method.

The mines are usually some distance from the calcining plants, and aerial trams are employed to carry the ore to them. An elaborate system of gravity planes and chutes is used at the mine of the Tulare Mining Co., near Porterville. In this installation empty cars are hauled back by horses.

In Washington, the mineral is crystalline and occurs as massive beds in a sedimentary series in which are found dolomite, shale, and quartzite into which basic igneous rocks have been intruded. Regular quarrying methods are employed in getting out the ore. Tunnels are run into the hill at convenient points and raises are put up to the

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[1] For further description see Bull. 355, Magnesite Deposits of California, F. L. Hess, 1918; Bull. 540–s, Late Developments of Magnesite Deposits in California, by H. S. Gale; and recent chapters of Mineral Resources, U. S. Geological Survey.

[2] A description of magnesite deposits in Washington was published in the Eng. and Min. Jour., Apr. 13, 1918; also in Mineral Resources (1917), U. S. Geological Survey.

[3] Washington "caustic" (burned magnesia) is cream white.

[4] W. C. Phalen, Min. and Sci. Press, Aug. 30, 1919; Can. Min. Jour., Mar. 1, 1918; Eng. and Min. Jour., June 28, 1919.

quarry floor. The ore is allowed to flow through such raises into small cars that are trammed by hand to the surface.

In Eastern Canada, Quebec, possesses the only known workable deposits of magnesite. The magnesite is coarsely crystalline and usually white, though sometimes blueish-gray or yellowish. The deposits are composed essentially of the magnesite mineral. Dolomite (lime-magnesium carbonate) it the principal accessory mineral, being practically always present, sometmes constituting a large proportion of the rock. Serpentine diopside and other minerals are frequently found disseminated, generally in small quantity, through sections of the deposits.

Quarrying is carried out by open cast methods, the rock being broken down by blasting and sledging to "one-man size." The quarried material is cobbled to separate it from excessive amounts of serpentine and highly dolomitic rock.

In Austria, the magnesite quarry at Veitsch contains one of the largest deposits and is representative of the methods of mining and preparing magnesite in Austria and in Hungary. The term "magnesite" is generally applied to the iron-bearing carbonate of magnesium, although Austrian magnesite is sometimes referred to as "bruennerite."

At Veitsch the magnesite, which occurs in the form of a lens, is quarried on the slope of a hill in a series of terraces about 50 feet apart. The entire work extends through a vertical distance of 500 feet. The huge magnesite lens is nearly three-quarters of a mile long and over 1,000 feet in width, and extends to a considerable depth. The magnesite occurs as lenticular masses in a belt of carboniferous rocks consisting mainly of metamorphosed shales, sandstones, conglomerates, and limestone. It is grayish in color when fresh and contains sufficient ferrous carbonate to blacken it when calcined. The material is blasted out of the solid by the ordinary methods of rock quarrying. It is next broken in pieces which can be handled readily by one man, and the dolomite and quartz are carefully picked out. Even in the best sections of the deposits, there is a large quantity of this gangue material and estimates of the waste rock vary from 50 to $66\frac{2}{3}$ per cent of all the material quarried. The coarse material is cobbed to free it as far as possible from impurities like schist, dolomite, and quartz, and the lumps are sorted. The cleaner portions of the magnesite are reduced to pieces about the size of a man's head. Less pure portions have to be broken into pieces about the size of a man's fist. These dressing operations involve a considerable loss of magnesite in the form of small fragments—too small to be burned in shaft kilns. The raw material thus obtained in the quarries at Veitsch is transported by gravity planes to the sintering kilns at the foot of the hill.

CALCINING METHODS.[1]

In the United States calcination is effected in different types of kilns: (1) Bottle-shaped kilns; (2) vertical kilns resembling lime-kilns; and (3) rotary kilns, like those used in the manufacture of cement. Distillate or crude oil is the chief fuel in use in California, but coke is employed at one plant. The distillate is sprayed with

[1] W. C. Phalen, Min. and Sci. Press, Aug. 30, 1919; Can. Min. Jour., Mar. 1, 1918; Eng. and Min. Jour., June 28, 1919.

air or steam into the four different compartments of the bottle-shaped kilns and the waste gases serve to heat the crude ore as it descends from the intake to the reverberatory chambers, where actual calcination takes place. Coke, where used, is mixed directly with the crude magnesite and its content of ash, therefore, has to be as low as possible. At most plants there is good economy of waste heat and action is practically continuous in all the different types of kilns. In general it may be said that American practice is comparable with foreign practice so far as rotary kilns are concerned. The sintering temperatures required for the production of dead burned magnesite are practically the same—approximately 2,800° F. in Austria, Canada, and the United States.

Capacity of kilns varies according to the different types. The usual practice in the bottle-shaped kilns gives 15 to 20 tons of calcine per 24 hours; in 125-foot rotary kilns, 60 to 75 tons per 24 hours; and in the vertical kilns, 7 tons per 24 hours. In the bottle-shaped kilns only coarse lump magnesite can be calcined; the fine can not be used for the reason that it obstructs the draft. In rotary kilns all sizes may be calcined, fine as well as lump.

At the plant at the Hemet Magnesite mine, Riverside County, Calif., a typical property, hand sorting is done on a 30 inch by 50 foot belt conveyer. The rejections from the sorting belt are run directly to the waste conveyer, which carries the material to the waste dump. The 12-inch conveyer takes the magnesite from the sorting plant to a Gilbert washing screen, where it is washed before going to the ore bin. The water, after screening the magnesite, is run to a Dorr thickener, where the solids are settled out and the clear water is again used. From the ore bin at the washer the magnesite is carried to the mill by a gravity surface tram.

From the 300-ton ore bin the ore is fed to a Wheeling crusher, set at 1-inch opening. The material after passing the crusher is elevated to the feeder supplying the kiln, which is of the rotary type 6 by 60 feet, making one revolution per minute. It takes the material about 45 minutes to pass through the kiln, and at the end of the calcination the magnesite is discharged on a steel conveyor, which distributes it on the cooling floor.

From the cooling floor the material is passed over a magnetic separator to take out any iron before going to the grinders. The grinding is done in two stages. The coarse grinder is a steel-plate mill which takes the 1-inch material and crushes it to about eight mesh. The fine crushers used are Sturtevant emery mills, which take the material at eight mesh and make 98 per cent pass 100 mesh in one operation. From the grinders the material is elevated to the bin, which supplies the packing department, where the material is all packed in barrels for shipment. The whole plant is operated by electric power.

Calcination yields two products. If the burning is carried to the point where 3 to 4 per cent of carbon dioxide is left, the product is referred to as "caustic" and is consumed principally in the flooring trade. Magnesia in this form is useless as a refractory material, because it absorbs moisture and CO_2 gas from the atmosphere and shrinks in volume when exposed to furnace temperatures. If burned to the point where it contains only one-half of one per cent of carbon

dioxide by weight, it is referred to as dead burned. Approximately 90 per cent of the total consumption of the United States is of the latter kind.

In Canada and Washington a dead burned or "ferromagnesite" is being produced at about 2,800° F., which has much the same refractory qualities as the Austrian iron-bearing magnesite. The ore is reduced to 10-mesh size by roll crushing, some 20 per cent passing through 100 mesh. Mixed with 2 to 5 per cent of its weight of pulverized magnetic iron ore, it is calcined in rotary kilns, at a temerature sufficient to convert all oxide of magnesium present, from the amorphous form to the crystalline, the latter being the stable and unchanging form of the oxide.

If the magnesia has practically no other oxides associated with it, the heat of the electric furnace (above 2,900° F.) must be used to accomplish the conversion. In the presence of other oxides, the transformation takes place at temperatures which are practical in brick kilns and shaft furnaces (about 2,600° to 2,700° F.). The resulting material—"ferromagnesite"—is the refractory magnesia of commerce, and consists, mineralogically, of ferrite of magnesia (MgO, Fe_2O_3) cemented and bound by the silicate of magnesia ($2MgO, SiO_2$). In this manner, American magnesite, of low iron oxide content, is brought into same final form as the Austrian dead-burned magnesia, in which the other oxides occur naturally. The average analysis of the dead-burned magnesite produced by one of the large American companies during part of 1918 and 1919 is reported to compare with a composite analysis of 21 samples of Austrian dead-burned material, as follows:

	Dead-burned magnesite.	
	American.	Austrian.
MgO	83.04	84.97
CaO	3.11	3.10
Mn_2O_3		.68
Fe_2O_3 / Al_2O_3	7.02	7.96
SiO_2	6.78	2.91
Ig loss		.38

A similar comparison of American and Austrian dead-burned magnesite appears in the testimony of the Harbison-Walker Refractories Co. in tariff hearings before the Committee on Ways and Means, July 17, 1919:

	Dead-burned magnesite.	
	American.	Austrian.
MgO	84.00	86.50
CaO	2.30	2.75
Mn_2O_3		
Fe_2O_3 / Al_2O_3	7.38	7.50
SiO_2	6.40	2.50
Ig. loss	.50	.50

In Austria, at the Veitsch sintering plant, continuous kilns of the bottle variety are used and producer gas is employed as fuel. Within the last few years a few plants have installed rotary kilns of the cement type, to burn magnesite, powdered coal being used as fuel. The magnesite can be burned as thoroughly in these kilns as in the bottle kilns, but they have one disadvantage, in that a larger per cent of fines is produced. The magnesite as burned in the bottle kilns is drawn every six hours.

The sintering temperature varies from 1,500° C. (2,732° F.) for bruenerite (Austrian magnesite) containing considerable iron oxide, to 1,700° C. (3,092° F.) for material poor in oxide. However easily the material sinters, it appears desirable to carry the temperature up to at least 1,500° C., but this temperature seems to be exceeded, as a rule, in the shaft kilns in Styria.

The magnesite, after being drawn from the kilns, is quenched with water and crushed to walnut size or less. It is then classified mechanically by screening or sizing into three different sizes. Much of the caustic lime or calcined dolomite is removed in the first screening owing to its finely divided condition. From the screens it goes to the picking tables, where the unburned magnesite, together with the dolomite and quartz, present in particles too small to have been removed at the quarries, are picked out. The magnesite in the larger sizes is again crushed and the smaller pieces repicked. The magnesite is finally crushed to the size of kernels of corn, picked over again, and sacked for the trade in packages of 150 to 200 pounds each.

In recent years magnetic separators have been introduced which have resulted in an economy in the picking or sorting operation. If not magnetically treated, the finely divided material would necessarily contain particles of schist, quartz, or other nonmagnetic minerals. It must be said, however, that the magnetic treatment involves some waste since only magnesite containing iron is removable by this treatment. It adds to the expense and is presumably employed only when it is necessary to obtain a concentrated, uniform, and most highly satisfactory product.

INDUSTRIAL DEVELOPMENT.

At the outbreak of the war the California industry was established quite firmly on the basis of medium-scale production and simple marketing systems, largely contractual. Since the freight rate on calcined magnesite is the same as that on crude and the product weighs only about one-half as much, practically all the ore was calcined at the mine. Various types of kilns were in operation. Most of them were of the vertical type, similar to those used for making quicklime—inexpensive to build, but rather wasteful of fuel. Crude oil was used at many plants, but in the more isolated sections, wood was cheaper. The character of the California deposits was such that extensive installation of equipment was not warranted. Single mines rarely remained in steady operation for any great length of time and no very large reserves were proved in advance of mining. At the end of 1913 there was only one producing company; in the whole year onl ythree companies had operated. Early in 1914, however, several old mines were reopened and a few new producers came in. The only large producer at any time before the war was the Tulare

Mining Co., and almost its entire product was contracted for by the Crown Willamette Paper Co. Only a few hundred tons surplus came on the open market. This was sold to grinders in San Francisco, who retailed it to consumers. The more or less sporadic output of the smaller organizations—none of whom could have guaranteed an output of 500 tons a month—came on the market almost wholly in granular form ("caustic") and in bulk.

War stimulation of the industry came in the latter part of 1914. It affected the larger properties first, but soon there was a rapid development of new producers. Mines 20 miles from railroads, that had never been commercially considered, were opened up and contributed to the output. One producer installed one and later another large rotary kiln similar to those employed for cement burning and improved its equipment generally. Broadly speaking, however, the California industry responded to the increased demand for its product by multiplying the number of producers—16 of whom reported production in 1915[1]—rather than by greatly expanding individual operations. In 1918, however, a discouraging and unexpected change took place when the demand for the mineral suddenly ceased; many mines closed indefinitely and others were compelled to reduce their output from one-third to one-half.

In Washington the somewhat greater inaccessibility of the deposits and their much greater indicated extent offered more attractions to large capital than to individual operations. The largest producer in the field is the Northwest Magnesite Co., which claims to have expended about $1,000,000 on equipment and development work.

Four companies took part in the development of the Washington industry. Extraordinary progress was made in the first two years of operation. A large part of the work done by these companies was purely development. The deposits are several miles from a railroad and the early operations involved hauling by wagon and motor truck. A year after opening their major deposits the largest producer completed a 5-mile aerial tram from the quarry to its new calcining plant, where three rotary cement kilns, 125 feet long by 7½ feet diameter, are installed. Both quarrying and calcining operations are equipped with modern machinery and labor-saving devices. The management is evidently enterprising. The latest development is the addition of iron ore, at the calcining plant, in correct proportions for the production of "ferromagnesite" of similar composition to the Austrian material. It is claimed to be quite as satisfactory as the Austrian product for refractory purposes.

DOMESTIC CONSUMPTION.

The consumption of magnesite shows a marked increase, and there is promise of a still further development in the next few years. In 1917 the apparent consumption, expressed as crude, was over 355,000 short tons, or about 25 per cent more than the consumption just before the war. The United States is the largest consumer of magnesite, and in 1913 its requirements amounted to over 65 per cent of the total world consumption, if 500,000 tons is considered as the world

[1] Sixty-five in 1917.

output for 1913. This quantity includes only exports from Austria-Hungary, and it is presumed that Germany, the second largest steel producer, must have used 150,000 to 200,000 tons of magnesite, and that the world's output was nearer 700,000 tons. If this is true the United States used about 50 per cent of the world's production of magnesite.

A recent estimate of the character of the consumption is that 82 per cent is used as refractory, 15 per cent in the plastic trade, and 3 per cent for chemical and medicinal purposes. The open-hearth steel industry is the most important factor in the magnesite situation. While this industry is not wholly dependent on magnesite supplies, it is largely so. The partial substitution of dolomite, however, has come to stay and the amount of magnesite consumed per ton of basic open-hearth steel, which formerly was 6 to 14 pounds (dead burned), has lately been cut almost in half. The total amount used by the steel industry has not decreased on account of the much greater output of basic open-hearth steel. The use of magnesite in building trades has also increased to a marked extent.

SOURCES OF DOMESTIC SUPPLY.

Over 90 per cent of the domestic supply of magnesite before the war was imported. The preponderant supply—and practically all that used in steel manufacture—was derived from Austria-Hungary. No other foreign sources of large supply of a satisfactory quality of material existed. The Grecian deposits furnished only "caustic" for use in plastic trades and in the manufacture of chemicals and heat-insulating material.

In 1917, however, the proportions were reversed and over 90 per cent of the domestic supply came from American deposits. The tendency in 1918, however, was toward largely increased importations of Canadian material. If there had been no restrictions on ocean shipments of this material (in the interest of ship saving), there would also have been large importations from Venezuela.

COSTS OF PRODUCTION.

In former years the bulk of shipments from California have been crude, but now there are a number of up-to-date calcining plants in California that are sending finished product to the eastern market. The Tariff Commission has made no independent investigation of production costs in the magnesite industry. Sworn statements of five of the largest companies operating in 1919 have been filed with the commission, showing an average cost of production of $25.37 per ton (calcined magnesite) at shipping point. In three of these reports the direct labor cost is indicated, averaging 50 per cent of the total. The Department of Commerce, in a cablegram from the American consul general at Vienna, has recently received figures on Austrian costs of producing magnesite, indicating that of a total cost f. o. b. Trieste of $12.80, $2.89 (or 23 per cent) is cost of labor. The Tariff Commission has had no opportunity to verify these figures and does not know from what source or with what accuracy the cost data have been assembled. One of the factors not itemized is transportation cost from the mines to Trieste.

The present transcontinental freight rate in the United States is the same for crude as for calcined material.[1]

FOREIGN PRODUCTION.

Developed magnesia deposits outside of the United States that have been productive are located in Quebec and British Columbia (Canada); Santa Margarita Island, Lower California; Venezuela, Austria-Hungary, Greece, Norway, Spain, Germany, Russia, Macedonia, Transvaal, and India. Deposits, some of which have produced small amounts, are located in Ontario and New Brunswick, Canada; Cedros Island, Lower California; Asia Minor, Sweden, Rhodesia, Portuguese West Africa, Australia, China, Japan, Tasmania, and New Caledonia. The largest foreign producer has been Austria-Hungary, with Greece second. The production of other countries was of minor importance until the war resulted in cutting off the Austrian supplies from all but the Central Powers. The cutting off of these supplies caused stimulation chiefly in the North American output. There is little reason to expect that there will be any marked shift in the important sources of supply, although the relative importance of the major producers may undergo considerable readjustment.

Magnesite reserves of the world.

[Communication from Mineral Resources Division, U. S. Geological Survey.]

	Short tons.
Austria-Hungary	120,000,000
Greece	5,500,000
Washington	7,000,000
California	750,000
Venezuela (Margarita Island)	[2] 3,200,000

The indicated reserves of the two American producing States are included for comparison. The reserves in other countries have not been measured, and no even approximately accurate estimate can be made as to the total resources of the world.

COUNTRIES OF LARGEST PRODUCTION.[3]

The foreign countries that enter into the American magnesia situation are Canada, Austria-Hungary, Greece, Mexico, and Venezuela. Small exports have been made from countries other than those named, notably Norway (via Scotland), but they are not of sufficient importance to warrant discussion with reference to the United States.

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[1] Rates, June 25, 1918, were \$15.60 plus 47 cents per short ton Spokane to Atlantic points; \$13.80 plus 41 cents to Pittsburgh. Some decrease in transportation expense may eventually result from Panama Canal service, but the haul from mines to Pacific ports, handling at docks, and freight from Atlantic seaboard to consuming center (Pittsburgh) will reduce the freight differential via canal.

[2] Caracristi, Charles F. Z., Eng. and Min. Jour., 107 (1919), p. 131.

[3] Data in regard to the deposits and the industry in the several countries are available in the auxiliary file of the Tariff Commission and in "Political and Commercial Control," Bull. 3, U. S. Bureau of Mines, by R. W. Stone.

Estimated world production.

[From Mineral Resources of the United States, Geological Survey, 1918.]

Countries.	1913	1917
	Short tons.	*Short tons.*
Australia	243	9,370
Austria-Hungary [1]	440,920	(2)
Canada [3]	515	58,090
Greece	106,482	159,834
India	17,637	19,445
Italy	661	....
Spain	992	1,653
Transvaal	661	860
Turkey	8,818	(2)
United States	9,634	316,801
Mexico, Norway, Russia	5,512	5,511
Total	592,075	571,565

[1] Exports.
[2] No data available.
[3] Shipments. From Mineral Production of Canada, Canada Department of Mines.

Austria-Hungary.—The magnesite deposits of Austria-Hungary follow a belt that extends in a northeast line across the two countries. The workable deposits are in the form of lenses. Only 10 or 12 of these lenses are of sufficient size to be worked, but several of these are of large size. The largest deposit in the group is near the town of Veitch. It has been worked longer than any of the others and a huge quarry is located there. The magnesite forms an isolated lens in a high hill surrounded by barren rock. From the top to the bottom of the workings is 700 to 800 feet. The quarry face is carried in benches about 50 feet high. Another large deposit in Austria is at Radentheim on the north side of the Millstatter Alps, where the material is quarried by great cuts and lowered by gravity to rotary kilns. This deposit was owned by an American company and much of the output came to United States ports. Both grain magnesite and magnesite brick were produced very near the mine. Another American company operated in Austria-Hungary before the war, but both properties were taken over by the Government and operated, at least for a time, by Russian prisoners. Two of the larger local companies sold all their export product through a German firm.

Because of the huge size of the Austrian and Hungarian deposits, and their comparative accessibility and low wages, the product can be marketed cheaper than any other known supplies. Even the best deposits in these countries contain a large quantity of dolomite and quartz gangue that must be sorted out by hand. But the extraordinary opportunity for cheap mining and the ease with which it may be calcined to a dead-burned state give these deposits a remarkable advantage over those of any other part of the world.

American capital is invested in the Austrian industry.

Greece.—Grecian magnesite is of the noncrystalline or amorphous type like that of California. The most important deposits are those of the island of Euboea, where they are all found close to the seashore. Cheap water transportation to all the principal consuming markets is available (under normal conditions). The largest veins are 50 feet or more wide and several hundred feet long.[1] They are mined by open cuts, and a very pure product is obtained by cobbing.

[1] Veins of this size not common, however.

In 1914 the production was mainly in the hands of three companies, and practically all the product is distributed through one of them—a British company. Less than 2 per cent of the ore is dead-burned on the island, and only about one-third of it is calcined before shipment. Before the war much of the crude material was shipped to northern Germany or Holland, where it was calcined and, in part, ground and packed for reexport, as prepared "caustic" for making Sorel cement. There has been some criticism of the Grecian caustic as delivered in the United States on account of its lack of uniformity. There is no reason why it should not keep practically indefinitely when properly packed. Magnesite from Greece and California are practically identical, but previous to 1915 the California material could not compete with the Grecian ore, much of which came in as ballast, because of high transcontinental freight.

Canada.[1]—The only important magnesite-producing district in Canada is Grenville, Quebec. Many other occurrences are reported. There are deposits of considerable extent in various parts of British Columbia, but on account of the cost of transportation are not workable at the present time.

The magnesite in the Quebec deposits is mixed with dolomite and serpentine, and the product invariably is high in lime. However, they have an advantage over the American deposits on account of their location close to centers of consumption, and increasing amounts are imported into the United States at Lake ports and along the St. Lawrence. The Quebec quarry deposits are also cheaper to mine than those of California. The Canadian geological survey reported in March, 1917, that the cost of Grenville magnesite laid down in the principal markets was from one-half to two-thirds that of the California product (presumably referring to crude). This advantage was expected to be further improved by construction of tramways from the deposits to the railroad. Canadian material cannot be used for the manufacture of the best magnesite brick. Material for brickmaking must be rigidly limited as to lime content (6 per cent) and silicon (7 per cent). The Canadian material is suitable, in the main, only for grain manufacture (furnace bottoms).

Mexico.—On the island of Santa Margarita, in Magdalena Bay, there are extensive deposits from which exports have been made to the United States. It is a mountainous island cut up by canyons in which massive magnesite several feet thick is exposed. Bowlders of the material strew the stream beds. Hundreds of thousands of tons are said to be in sight, and large quantities can be obtained with no expense for mining, requiring only to be broken up for shipment. Some of this material was being calcined in California in 1917, but the boat that carried it was diverted to other uses by the United States Government. The material is exceptionally pure, and the operations were conducted by Americans.

Venezuela.—Large deposits of the massive or California type are found on Margarita Island, off the coast of Venezuela. In 1915, 500 tons were exported to the United States. During most of the year the United States Shipping Board refused to grant a license for further shipments. Mines are developed sufficiently to produce 2,000 tons monthly of very high-grade material. During 1917 the

[1] Canadian deposits are fully described by Wilson: Magnesite Deposits of the Grenville District Department of Mines, Memoir 98.

output was about 10 tons a day and brought an average of $25 a ton, of which $19.50 was paid for freight. The properties are operated by residents of California.

COMPETITIVE CONDITIONS.

DEPENDENCE ON TRANSPORTATION.

The important feature of the magnesite industry is its dependence on cheap transportation for the successful exploitation of its product. Carbonic-acid gas bottlers were forced to resort to limestone in place of magnesite in California, largely because freight from mine to quarry to manufacturing plant more than offset the advantages of the richer (in gas) material. For this reason shipments of crude are restricted to very short hauls. Crude has, in fact, almost wholly disappeared from the city markets. The sudden increase in production in 1915 resulted in some resumption of shipments of crude magnesite from the mines, but these ceased as soon as kilns could be constructed at the new mines.

The freight rates by rail from San Francisco to Chicago just before the war were $10 a ton; to Illinois and Ohio points, $11; and to Pittsburgh and beyond, $12. The average price of domestic crude in the San Francisco market was about $8 a ton. The average import valuation of Grecian magnesite (which was more strictly competitive with the California product then the Austrian) was $7 to $8 per ton on board steamer in New York. Under free competition the definite line of equal price was invariably west of the Mississippi River. Since the largest markets are in the Eastern States the domestic output was restricted to the rather limited local market in California on a purely cost basis. Calcined (not ground) Euboean (Grecian) magnesite was usually sold in New York cheaper than was similar material at the mines in California. The competitive status of Austrian supplies was also dependent on the freight, since the dead-burned product in New York was even cheaper than Grecian "caustic."

A freight rate of $4 a ton from San Francisco to points on the Atlantic seaboard through the Panama Canal was quoted when the canal was first opened but was later increased to $7 as the scarcity of bottoms became apparent. Eastbound magnesite, however, was never sought by carriers.

When the supplies of Austrian magnesite were finally cut off the California producers became a factor in the eastern market and for a time were practically free from outside competition. Later, however, Canadian deposits were developed, and although the material contained much more lime than the domestic product and was consequently less desirable for open-hearth steel production, it was so much cheaper because of the relatively short haul that it became an important rival of the Pacific Coast product. Washington deposits were discovered and opened up in 1916, and largely supplied the market for refractory material in 1917 and 1918.

QUALITY OF PRODUCT.

While the chief handicap to the domestic producers is their distance from the points of consumption, the extreme purity of the

product also had an important bearing on the situation. It is commonly assumed that the most refractory magnesite is the dead-burned calcined form (either as brick or in grains) containing little or no lime, silica, iron oxide, or alumina. Lime has a tendency to cause disintegration and also in steelwork may "become rotten," due to absorption of phosphorus that should have gone only into the slag. All the other impurities have a tendency to lower the melting point. On the other hand, there is a decided preference among refractory users for the magnesites that carry a certain percentage of iron as do the Austrian and Hungarian products. While the small amount of iron present does lower the melting point slightly, brick and other calcined products made from it are more satisfactorily burned and hold their shape better when exposed to high temperature. The shrinkage is less, and less heat is required for satisfactory calcination than is the case with the purer American material. In order to meet this condition, at least one of the American producers has installed mixing devices for adding iron to its product prior to calcination.[1]

Five analyses of Austrian crude magnesite show:[2]

	Per cent.
Magnesia (MgO)	85.53–90.07
Lime (CaO)	.96– 3.52
Iron oxide (Fe_2O_3)	7.43– 9.96
Alumina (Al_2O_3)	2.22
Manganese oxide (Mn_3O_4)	.51– .76
Silica (SiO_2)	.26– 1.34

California and Washington magnesite has much the same analysis as the Austrian material shown above, with a tendency to run lower in iron and higher in silica. In certain deposits the American material very closely approximates the Austrian.

Another feature that may be mentioned under this head is the preparation of the material. Even before the war, Grecian magnesite was sold in California in competition with the domestic product for the plastic trade and at a higher price. Discounting the prejudice or established custom of calling for "Grecian" magnesite in specifications, the greater diversity of forms and packages in which the imported product was available and the fact that it could be bought in small lots was a strong factor in its continued sale. The domestic producers invariably sold only in carload lots. Very little of their product was marketed in the ground condition ready for use. On the other hand, the imported material was ground, of uniform grade, and packed in paper-lined barrels.

FOREIGN EXCHANGE.

Another influence probably affecting the relative competitive positions of American and foreign producers is the present low rate of foreign exchange. Comparatively one-sided trade relations have existed during the last five years between the United States and foreign countries, and the virtual abandonment of the gold stand-

[1] Two California deposits contain enough iron so that magnesite brick are made without the addition of that material. It is claimed that eventually this purer American material will be regarded as a more satisfactory refractory than the Austrian product.
[2] F. Cornu. Zeit. T. Prakt., Geol., 1908.

ard in various European countries has resulted in the depreciation of their currencies. The competitive strength of Austrian magnesite is subject to whatever uncertainties attend the present exchange rates on the Austrian krone. The Tariff Commission is endeavoring to ascertain both the effects of any divergencies between foreign and domestic depreciations of currency and the effects of exchange rates due to the balance of trade on the competitive position of the foreign commodity in the American market.

IMPORTS.

COUNTRIES OF ORIGIN.

The Department of Commerce publishes the countries of origin for importations of calcined but not of crude magnesite. In general, it may be said that Greece furnished a larger proportion of raw magnesite before the war than did Austria-Hungary. Raw magnesite has also been imported quite steadily from Canada in late years. The irregular imports from Mexico and Venezuela have been mentioned above, as has also the character of the importations from the various countries.

Most of the pre-war importation of calcined magnesite from Netherlands, Belgium, Germany, and even the United Kingdom consisted of re-exported Grecian "caustic," generally after calcining and repacking in those countries. Part of the imports from Great Britain (Scotland) was of Norwegian origin.

Imports by countries, magnesite, calcined, not purified.

[Fiscal years ending June 30.]

Imported from—	1911		1912		1913	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Austria-Hungary	286,784,390	$1,282,298	198,208,783	$916,550	327,430,519	$1,564,234
Germany	2,851,020	18,474	1,378,678	16,600	4,823,513	40,833
Netherlands	5,948,054	59,608	4,819,284	52,806	9,015,619	100,175
Belgium	65,230	667	51,211	530	....	....
Greece	....	....	227,276	1,173	3,208,176	17,462
Norway	242,716	1,648	325,760	1,893	....	....
United Kingdom	5,560	36	123,192	1,062	2,789	47
Canada	591,940	1,726	467,920	2,863	700,630	5,097
All other	55,777	533	276,880	986	....	....
Total	296,544,687	1,364,990	205,878,984	994,463	345,181,246	1,727,848

Imported from—	1914		1915		1916	
	Pounds.	Value.	Pounds.	Value	Pounds.	Value.
Austria-Hungary	268,520,275	$1,298,136	104,171,512	$523,905	....	....
Germany	5,156,102	42,146	1,444,691	16,417	24,802	$365
Netherlands	8,380,349	107,261	7,108,042	101,513	3,899,359	59,155
Belgium	22,310	289	....	....	....	....
Greece	6,464,400	20,070	8,873,777	47,511	22,825,795	136,701
Norway	....	....	....	....	44,840	611
United Kingdom	26,508	654	560,563	16,381	698,100	31,553
Canada	808,650	3,300	1,895,424	14,065	4,879,714	54,383
All other	115,722	1,351	2,641,421	25,590	....	....
Total	289,494,316	1,473,207	126,695,430	745,382	32,372,610	282,768

Imports by countries, magnesite, calcined, not purified—Continued.

Imported from—	1917		1918		1919	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Austria-Hungary					107,520	$664
Greece	3,584,000	$28,032				
Norway			22,046	$482		
United Kingdom	1,568,424	86,224	1,864,794	105,507	925,120	53,480
Canada	4,296,393	67,781	21,608,707	443,538	39,401,280	535,310
All other			4,242	200		
Total	9,448,817	182,037	23,499,789	549,727	40,433,920	589,454

Imports for consumption, magnesite, calcined, not purified.

Fiscal years.	Rates of duty.	Pounds.	Values.	Value per unit of quantity.
1907	Free	143,891,572	$698,715.45	$0.005
1908	...do...	146,860,775	706,088.00	.004
1909	...do...	186,961,370	871,383.80	.005
1910	...do...	225,895,904	1,026,982.00	.005
1911	...do...	296,225,507	1,362,120.00	.005
1912	...do...	204,997,478	990,241.00	.005
1913	...do...	345,322,155	1,731,443.00	.005
1914	...do...	288,989,577	1,485,273.00	.005
1915	...do...	125,893,407	751,766.00	.006
1916	...do...	32,372,610	282,768.00	.009
1917	...do...	9,448,817	182,037.00	.019
1918	...do...	22,764,029	535,202.00	.024
1919	...do...	27,009,920	532,020.00	.020

PRICES.

The price statistics for magnesite are somewhat complicated because of the variety of grades and methods of packing. Except for Austrian dead-burned material, the different products have not been well standardized and statistics for successive years are not comparative. Magnesite "raw" and "calcined" are the only two classes quoted in trade journals with any degree of regularity. But these quotations are nominal and rarely reflect even major fluctuations.

Before the war the lowest prices for dead-burned Austrian magnesite were $15.72 f. o. b. docks at Philadelphia, $15.60 f. o. b. New York, and $15.20 f. o. b. New Orleans. These figures represent the practical minimum prices that had been reached in 15 years. In rough figures the average price of calcined magnesite along the Atlantic seaboard was $16.25 per net ton. An approximately average freight rate from Atlantic points to Chicago was $2.40 a ton, yet the lowest f. o. b. Chicago price quoted for the material in 1914 was $26 per short ton.

The minimum pre-war price of raw magnesite was $8 per net ton on the Atlantic seaboard, and was usually quoted higher. Material (Grecian) calcined for medicinal and other uses ranged from $20 to $25 per ton, according to its purity and the care that had been exercised in sorting. Fine ground calcined brought up to $35 and $40. Little information can be gained by a study of the import valuations, except that they bear out the fact that shipments from Europe, except from the producing countries, are of material especially ground and packed. Magnesite from the United Kingdom has the highest valuation ($49.40 per ton in 1914), while the Austrian material was

valued at $9 to $10 and the Grecian imports were generally valued at slightly over $10.

The proportion of magnesite imported raw showed a gradual falling off from more than one-half the weight of the magnesite imported as calcined in 1902 (the first year for which separate statistics are published) to about one-twelfth the weight of calcines imported in the years immediately preceding the war—a natural result of established routes and the tendency to ship in the lightest possible form. The amount of calcined magnesite imported in 1914 was nearly 150,000 tons, valued at $1,500,000, or more than five times the quantity imported in 1904. On the other hand, the 11,000 tons of raw magnesite imported in that year was an actual reduction from the annual importation a decade before.

When the war first cut off the importation of Austrian calcines, a much larger proportion of raw material was imported, since no other country had sufficient calcining facilities immediately to take care of the sudden demand. Even some of the Grecian magnesite that ordinarily would have been calcined in Europe en route was shipped direct and the imports of raw magnesite from that country greatly increased, as also did those from Canada later. In 1917 the importation of crude magnesite was the largest on record, both as regards quantity and value, amounting to nearly 90,000 tons, valued at $750,000, or nearly nine times the amount and 16 times the value of the 1914 imports. In that fiscal year the imports of calcine reached their minimum—less than 5,000 tons, valued at only $182,000, or less than one-thirtieth of the amount and about one-eighth the value of the 1914 imports. In 1918 the import restrictions of the United States Shipping Board cut down the amount of crude magnesite imported to one-tenth that imported in the previous year. Increased rail and lake boat shipments from Canada, which had meanwhile increased its calcining capacity to keep up with the sudden increase in its mine output, resulted in more than doubling the importation of calcined material.

REVENUE.

Since magnesite has always been on the free list, the Government has never gained any revenue from its importation. The imports for consumption since 1907 are as follows:

Imports for consumption, magnesite, crude.

Fiscal years.	Rates of duty.	Quantities. (pounds).	Values.	Value per unit of quantity.
		Pounds.		
1907	Free	44,648,557	$156,722.00	$0.004
1908	do	42,722,846	141,992.00	.003
1910	do	20,725,355	39,558.00	.002
1910	do	34,175,514	108,623.25	.003
1911	do	37,951,190	127,344.00	.003
1912	do	29,415,095	88,482.00	.003
1913	do	33,654,260	111,276.00	.003
1914	do	21,590,605	46,611.00	.002
1915	do	37,463,509	80,625.00	.002
1916	do	101,591,459	281,620.00	.003
1917	do	179,292,638	748,951.00	.004
1918	do	18,532,767	104,947.00	.006
1919 [1]	do	4,424,000	57,434.00	.013

[1] These figures appear high. Bureau of Foreign and Domestic Commerce is investigating accuracy (November, 1919).

The only quotations for the domestic product before the war were in California. In general they did not differ greatly from the quotations for imported magnesite in the East. In the early years of the war, San Francisco became the dominant market. Quotations rose from $22 to $25 per ton for crude calcines in sacks and $40 to $55 for the ground product in paper-lined barrels.

New York market quotations in June, 1919, for the domestic product were $30 to $35 per ton for crude and $50 to $60 per ton for calcined. There was no European magnesite on the market at that time.

Several cargoes of Austrian calcined magnesite arrived in this country during August, September, and October, 1919—2,044 short tons in all, with average import valuation of $23.73.

Prices of magnesite, 1913 (wholesale, per short ton).

New York market:	
Grecian, Eubœan, calcined, "caustic," fine ground (in paper-lined barrels)	$25.00–$35.00
Grecian, Eubœan, calcined, "caustic," not ground (in sacks)	17.50– 20.00
Grecian, Eubœan, crude (bulk)	7.00– 8.00
Austrian, calcined, dead burned, crushed or fine ground (bulk)	16.15– 16.25
Pacific coast markets (San Francisco or Los Angeles):	
Domestic, calcined, "caustic," fine ground (in paper-lined barrels)	30.00– 35.00
Domestic, calcined, not ground, dead burned (in sacks)	20.00– 25.00
Norwegian, calcined, dead burned, crushed or fine ground	22.50

TARIFF HISTORY.

Magnesite, both crude and calcined, has been free since 1883. The tariff history may be tabulated as follows:

Act of—	Paragraph.	Tariff classification or description.	Rates of duty, specific and ad valorem.
1883	620	Magnesite, or native mineral carbonate of magnesia	Free.
1890	640	....do	Do.
1894	543	....do	Do.
1897	[1] 605	Magnesite, crude or calcined, not purified	Do.
1909	618	....do	Do.
1913	539	....do	Do.

[1] As passed by the House of Representatives the provision read: "Magnesite, or native mineral carbonate of magnesia, all not medicinal." The change of the wording as enacted was made in the Senate.

Summary table.

Calendar year.	Domestic production (short tons).	Imports for consumption (short tons).[1]	Domestic exports.	Ratio of imports to domestic production (per cent).	Value (imports for consumption).[1]	Value per unit of quantity.[2]
1910	12,443	323,654	None	2,610	$1,542,800.00	$6.25
1911	9,375	257,124	...do	2,740	1,185,867.00	5.86
1912	10,512	268,408	...do	2,550	1,369,665.00	5.83
1913	9,632	347,426	...do	4,020	1,757,476.00	6.40
1914	11,293	256,987	...do	2,280	1,377,772.00	4.10
1915	30,499	102,913	...do	337	647,211.00	5.12
1916	154,974	93,885	...do	61	838,630.00	8.42
1917	316,838	38,208	...do	12	464,706.00	7.66
1918	231,605	43,531	...do	19	927,255.00	21.30

[1] Quantity of imports of calcined have been doubled (assuming a 50 per cent loss in weight because of the calcining operation) and added to quantity of crude. Values of calcined simply added to those of crude in this table.

[2] Based on imports of crude only.

COURT AND TREASURY DECISIONS.

In a decision in 1876, ground magnesite, or native carbonate of magnesia, composed of magnesia 47.6 and carbonic acid 52.4, was classified as carbonate of magnesia, although differing in some respects from the more common article known by that name. (Dept. Order, T. D. 2875.)

Calcined magnesite, declared to have all the characteristic properties of cement and to be used as a mortar in cementing magnesite bricks, was classified as cement under the act of 1883. (T. D. 9375.)

An importation described as "calcined magnesite, or magnesite which has been reduced to pulverization by heat and then ground." and chiefly used as a cement for lining furnaces, was held not within the provision in the act of 1894 for "magnesite. or native mineral carbonate of magnesia," nor gypsum ground or calcined, but dutiable as cement other than Roman, Portland, or hydraulic. (G. A. 3370, T. D. 16851.)

A similar importation was classified as cement by the customs officers under the act of 1897, but the Board of General Appraisers held it exempt from duty as "magnesite, crude or calcined, not purified," a broader provision than that in the former law. (G. A. 5003, T. D. 23316.)

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LIST OF PRODUCERS IN 1918 AND CHARACTER OF PRODUCT.

California:

- Piedra Magnesite Co., Fresno (calcined).
- J. H. Plattner, Livermore (crude).
- Sinclair Bros. & Ferguson, Piedra (calcined).
- Bay Cities Water Co., Coyote (crude).
- Western Magnesite Development Co., 519 California Street, San Francisco (crude and calcined).
- Gustine Magnesite Co., Ingomar (crude).
- Red Mountain Magnesite Co., Marine Building, San Francisco (crude and calcined).
- Standard Magnesite Co. of California, 244 California Street, San Francisco (crude).
- E. Duryee, 1205 Hollingsworth Building, Los Angeles (crude).
- H. T. Haden, Dinuba (crude).
- Oakland Magnesite Co., Realty Syndicate Building, Oakland (crude).
- Harker Magnesite Co., Guerneville (calcined).
- Fred Leighton, Cloverdale (crude).
- Nichelini & McKenzie, Chiles (crude).
- J. D. Hoff Asbestos Co., Monadnock Building, San Francisco (calcined).
- R. Schiffman, Pasadena (crude).
- C. G. Gohlin, St. Helena (crude).
- Hugo Fischl, Hollister (crude).
- H. Sherlock, Madrone (crude).

The following were believed to be operating at the end of 1918:

- Frank R. Sweasy (White Rock mine), Humboldt Bank Building, San Francisco (crude and calcined).
- Wellman-Lewis, 901 Hibernian Building, Los Angeles (crude and calcined).
- Sonoma Magnesite Co., Humboldt Bank Building, San Francisco (crude and calcined).
- Tulare Mining Co., 310 Sansome Street, San Francisco (crude and calcined).
- Porterville Magnesite Co. of California, Porterville (crude and calcined).

Washington:

- American Mineral Production Co., 622 Insurance Exchange Building, Chicago, Ill.
- Northwest Magnesite Co., Hutton Building, Spokane.

(Both these companies are operating—February, 1919—and produce both crude and calcined.)

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